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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :
Duvall *et al*
Serial No. 09/098,758
Filed: June 17, 1998
For: Synergistic Blend of a Metal-Based
Stabilizer or Lewis Acid and a Free Mercaptan
for Enhanced PVC Stabilization

Group Art Unit: 1713
Examiner: P. Mulcahy

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on November 29, 2001.

Robert M. Didrick
Robert M. Didrick

Assistant Commissioner for Patents
Washington, D.C. 20231

RESPONSE UNDER 37 CFR 1.116

Dear Sir:

This application has been reconsidered carefully in the light of the Office Action mailed November 6, 2001. Reconsideration of the application in the light of the following remarks is requested respectfully.

The rejection of claims 1-3 and 6-9 under 35 USC 103(a) as being obvious over the teachings of Snel taken alone on the ground that Snel teaches the incorporation of zinc chloride and mercaptan compounds in a chlorine-containing resin is traversed. To the contrary, Snel teaches the incorporation of zinc chloride and ethoxylated mercaptan compounds in a chlorine-containing resin. The ethoxy groups add at the sulfhydryl group to create a sulfide terminated by a polyethoxyethanol group, as taught at column 3, line 46 of Snel. It is the cooperation between the mercaptan and the zinc chloride in the instant claims that makes the applicants' invention work. It is respectfully submitted that one of ordinary skill in the art of PVC stabilization would not be guided by Snel to believe that a mercaptan should used with the zinc chloride instead of

the alcohol. It would not suggest a polymer composition in which a free mercaptan and zinc chloride are the only stabilizers.

It is taught at pages 816-817 in Part 2 of The chemistry of the thiol group that amines catalyze the oxidation of thiols to disulfides in hydrocarbon solvents. Copies of those pages along with the title pages are enclosed. It is respectfully submitted that the polyimines of Snel be excluded from the claimed composition because they would act as amines in the claimed polymer composition and have a material effect on the basic and novel characteristics of the acidic mercaptan therein.

The rejection of claims 1-3 and 6-9 under 35 USC 103(a) as being obvious over the teachings of Snel in view of Pollock on the ground that Pollock more clearly shows the instantly claimed free mercaptans and further suggests the use of co-stabilizers which can include zinc chloride in polyvinyl chloride polymers is traversed. The use of the mercaptan stabilizers of Pollock in the compositions of Snel would not make Snel more suggestive of a polymer composition in which a free mercaptan and zinc chloride are the only stabilizers. Pollock teaches at column 3, lines 52-56 that the mercapto acid or mercapto alcohol alone imparts no stabilizing effect upon polyvinyl chloride resins but in combination with the organotin mercaptide lessens or entirely prevents development of yellow discoloration during heating. Pollock is telling one of ordinary skill in the PVC stabilization art that the mercaptan would not have any effect even when one of the costabilizers taught at column 10, lines 20+ such as a zinc carboxylate is used. Pollock goes on to teach that the organotin mercapto acid ester causes initial cloudiness and discoloration in the resin but the mercaptan can reduce these effects. There is no suggestion that another metallic salt may be substituted for the organotin mercaptide. Pollock teaches away from the instantly claimed composition.

Moreover, it is respectfully submitted that the organotin mercapto acid ester is excluded from the scope of the instantly claimed composition because, according to Pollock, it does have a material effect on the basic and novel characteristics of the PVC composition in which it is present along with a mercaptan and a zinc salt, be it a carboxylate or chloride.

Furthermore, the mercaptans taught by Pollock would also be subject to the reaction with

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the polyimines of Snel. A composition made by combining the teachings of Pollock and Snel would be materially and detrimentally affected by the combination of a polyimine and a mercaptan. The combination of those references, therefore, is not a valid ground for the rejection of the instant claims.

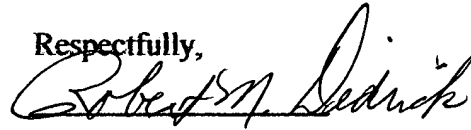
For all of the foregoing reasons, a withdrawal of the final rejection is courteously solicited.

Date: Nov. 29, 2001

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Respectfully,



Robert M. Didrick

Attorney for applicants

Registration No. 25,135

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The chemistry of the thiol group

Part 2

Edited by

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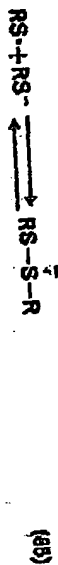
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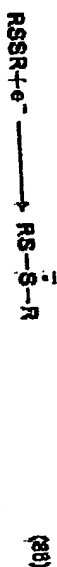
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Although the dimerization of thiol radicals has been found to be very fast (10^6 – 10^8 M⁻¹ sec⁻¹) the very low concentration of such species could still make the search for an alternative path to disulphide formation rewarding. It may be worth mentioning that Capozzi and Granzy¹⁴ observed that mercapto radicals generated by flash photolysis in aqueous solutions give rise to a radical ion, possibly by interaction with an ionized thiol molecule (equation 85).



Similar radical anions have been observed¹⁵ as transient species in the reaction of various disulphides with hydrated electrons (equation 86) which eventually decay to give thiol radicals and mercapto ions (equation 85 from right to left).



A related observation was reported by Zweig and Hoffmann¹⁶ who observed a one-electron reduction of naphthalene 1,8-disulphide, contrary to the more usual two-electron reduction of disulphides (see Section II) and also that the radical anion generated from this disulphide with sodium in 1,2-dimethoxyethane has an ESR spectrum characterized by a single line with 1.04 gauss separation from peak to peak, $g = 2.0110$. The electrochemical generation of the same radical partially resolves the line into an overlapped 1:2:1 triplet, $a_N = 0.4$ gauss. The lack of coupling of the unpaired electron with the aromatic π system indicates that the electron is localized on sulphur. This, in turn, suggests that disulphide radical ions may be a relatively long-living species and hence reaction intermediates. Indeed, under special experimental conditions¹⁷ or with special geometrical configurations they live long enough to be physically detected.

B. Catalysis by Aliphatic Amines

Thiols and in particular aromatic thiols are acids strong enough to be partially transformed into their conjugate base by amines. It follows that the oxidation of thiols by molecular oxygen, which is much faster on the anion than on the undissociated thiol (see section III.A), may be catalysed by aliphatic amines acting simply as base (see, however, section III.D). These catalysts have been used¹⁸ in the oxidation of thiols in hydrocarbon solvents in which amines, but not the more basic alkali hydroxides, are soluble.

The hypothesis that the amine-catalysed oxidation of thiols is a particular case of the more general reaction of oxidation by molecular oxygen of thiolate ions is confirmed by the finding that arene-thiols, which are more acidic and hence more dissociated, are oxidized faster than arylalkane- and alkane-thiols in the presence of amines¹⁸.

A special case of combination of amine catalysis and solvent effect is given by the easy oxidation of aliphatic and aromatic thiols in tetramethylguanidine which acts both as base and as a dipolar aprotic solvent (see Table 14).

TABLE 14. Oxidation of thiol to disulphides in tetramethylguanidine at 23.5°C. ± 1%

Thiol	Disulphide yield, %	Reaction time, h
<i>n</i> -Propanethiol	82	19
<i>i</i> -Propanethiol	82	19
<i>n</i> -Pentanethiol	82	19
Cyclohexanethiol	72	16
α -Toluenethiol	12	43
Benzeneethiol	80	19

^a Constant oxygen pressure 1 atm.

C. Catalysis by Metal Ions

The addition of heavy metal salts to the basic aqueous solution of thiols increases the rate of oxygen uptake, as shown in Table 15. It may be easily realized that the catalytic activity varies with the metal ion. The oxidation gives, except for very special cases (see below), only disulphide without any contamination by products of further oxidation (Table 16). The stoichiometric relation of one mole of oxygen for four moles of thiol has always been observed (equation 65).

The results reported in Table 15 have to be considered to be only qualitative; indeed many of the metal ions listed give in the reaction medium slightly soluble oxides and hence formation of precipitates is observed. The addition of thiols to these non-homogeneous solutions causes changes in the amount, colour and possibly nature of the insoluble material. In some cases the nature of the precipitate formed was investigated; in particular $Co(SC_2H_5)_2$, $Pd(SC_2H_5)_2$, $TiSC_2H_5$, $Ni(SC_2H_5)_2$ and $(C_6H_5)_3N(OH)$ were identified in the oxidation of C_2H_5SH catalysed by Co^{2+} , Pd^{2+} , Ti^{4+} and Ni^{2+} respectively.